Boeing Digital Leadership Shaping New Era for Defense, Aerospace

The U.S. Department of Defense has called on industry to embrace digital engineering to rapidly deliver new warfighter capabilities and Boeing is accelerating that change.

In August 2020, Gen. C.Q. Brown Jr., chief of staff of the U.S. Air Force, issued a report on the strategic challenges ahead for the service and the consequences of failure to the nation. In “Accelerate Change or Lose,” Gen. Brown proclaims, “If we fail to adapt to the changes in the strategic environment, a large and growing body of evidence suggests that we risk losing in great power competition.”

The change needed, said Gen. Brown, is a focus on joint warfighting and “rapidly [moving] forward with digital, low-cost, high-tech warfighting capacities” through DoD and industry collaboration. Boeing is responding to that call to action by bringing two decades of digital engineering experience to create transformative capabilities for its customers.

Years before the Air Force published “Accelerate Change or Lose,” Boeing began digitally innovating to redefine how the latest capabilities could be delivered to the warfighter with greater speed, flexibility and value, and apply the right analytics to meet their evolving mission needs.

Leanne Caret, president and CEO of Boeing Defense, Space and Security, says the company’s mission today is to deliver the most digitally advanced, simply and efficiently produced and intelligently supported solutions to global customers.

“Boeing’s first century was defined by ***what*** we built, this century will be defined by innovations in ***how*** we build and support,” she says. “While we’ve seen competitors play catch-up and focus on either digital design or production, Boeing is the one company addressing both, in conjunction with digital sustainment.”

From Virtual to Reality: Digital Designs Coming to Life

Nearly a decade ago – in early 2012 – Boeing's secret "Black Diamond" project demonstrated many advanced design and manufacturing techniques that have since been scaled into production on new and legacy platforms. Early prototyping exercises experimenting with the power of full-size determinant assembly were demonstrated in 2014, and have since been implemented into production on the F-15EX Eagle II, T-7A Red Hawk, MQ-25 Stingray and other programs, resulting in increasingly cost-effective and higher quality production for customers.

The Boeing MQ-25 Stingray (left) transfers fuel to a U.S. Navy F/A-18 Super Hornet on June 4, 2021, marking the first time in history that an uncrewed aircraft has refueled another aircraft. The MQ-25 was developed using Boeing's advanced expertise in model-based digital engineering and design. (Boeing photo)

In order to give defense customers the digital edge they need to field faster and fight smarter as a connected force, Boeing is embracing digital transformation across the entire value stream and implementing advanced production methods that place operators first – starting with design. Boeing is able to create hundreds of digital models and test them for thousands of hours in virtual environments before ever cutting metal, significantly reducing build and test cycles.

Boeing's T-7A Red Hawk is proof that this digital approach to design works. Engineers applied model-based engineering and advanced manufacturing and testing techniques to move from computer screen to first flight in just 36 months.

The Boeing T-7A Red Hawk has been recognized for its role in initiating the defense industry's digital revolution. The program used digital engineering processes, agile software development and an open architecture mission system to enable more rapid, affordable future aircraft development and affordable sustainment and is the model for all future defense programs. (Boeing photo)

Before building the two physical T-7A production representative jets, full-scale interactive 3D virtual models enabled engineers to assess platform configurations for supportability and maintenance, as well as ergonomic aspects of the assembly process. Interacting with the virtual product and influencing design changes early in the design cycle maximized efficiency through the value chain.

The result was a digitally-native platform. Once fielded, T-7A digital twins will tell the ecosystem that supports each trainer exactly what it needs to be successful. Each aircraft will tell the supply chain when it needs a part, how and when it should be maintained, and how individual operators and maintainers could care for and operate it even better.

Meanwhile, on the F-15EX Eagle II program, Boeing leveraged many of the same tools to accelerate the creation of one of the most digitally advanced, flexible and upgradable fighters ever. The F-15EX was digitally remastered and tested for thousands of hours in virtual environments, reducing fabrication time and unlocking insights to simplify field maintenance. F-15EX moved from contract award to an early delivery to the Air Force in a matter of months.

Boeing's Airpower Teaming System (ATS) uncrewed aircraft or "Loyal Wingman," developed in partnership with the Australian government, is both autonomous and digitally-enabled. Similar to T-7A, ATS was created using advanced processes leveraging the power of the digital thread and purposefully designed for producibility. Boeing's digitally engineered ATS went from design to first flight in less than 36 months.

Boeing's digital design and testing expertise enabled Airpower Teaming System to become Boeing's largest uncrewed program outside the United States and Australia's first domestically developed combat aircraft since World War II. ATS accompanies manned aircraft and is capable of performing air-to-air and air-to-ground combat, electronic warfare, and intelligence, surveillance and reconnaissance missions. (Australia Department of Defence photo)

Investing in Smarter Production and Product Support

Soon, Boeing's production centers will incorporate additional modularity to increase flexibility, allowing it to respond faster as customers' operational requirements evolve. Connected factories will leverage artificial intelligence to ingest and analyze information across the company's entire production system, giving a real-time view of production system health, parts location and availability, safety, quality, and performance.

Elements of Boeing's future production system are operational today, and high-volume production lessons from the company's commercial unit are being infused into the Boeing defense production system architecture to accelerate deployment of digitally enabled technologies.

Boeing is also revolutionizing how it maintains and modernizes customer fleets through data-driven product support – a paradigm shift from chasing readiness to driving readiness across the spectrum. In the past and still today, the system informs how aircraft are supported, resulting in unstable readiness and higher costs. Boeing's digital approach to sustainment means that simulated and real-world aircraft data inform the system, leading to more predictable, available and affordable readiness at less cost.

“We are creating an environment in which every tail number, every asset, every sortie and every person builds data connectivity to help operators predict their support needs before platforms are even fielded,” says Ted Colbert, president and CEO of Boeing Global Services.

“Imagine how much more successful our customers will be when we stop delivering and storing parts based on historical data, stop training every pilot and maintainer the same way, or stop performing heavy maintenance on a set schedule. Instead, we can let each platform tell the supply chain what it needs, when it needs it, measure individual learning and aptitude, and send an aircraft to the depot based on its individual data,” Colbert says.

Boeing’s digital expertise is at the core of its services business, which has been recognized for its work enhancing existing programs such as the C-17, B-52 Commercial Engine Replacement Program and A-10 Thunderbolt II wing replacement program. Boeing also applies analytics insights to maintenance, sustainment and training systems, providing full lifecycle support to both new and in-service programs. (Boeing photo)

Boeing ‘all-in’ on Open Architecture

Combining hardware-agnostic, open software approaches with artificial intelligence and cloud environments, Boeing’s commitment to open architecture avoids vendor lock while enabling scalable digital infrastructure and cross-platform mission software. This allows for rapid capabilities insertion and a seamless user experience across platforms.

“Boeing sees the value that is created for the warfighter through open architectures and is committed to the DoD’s vision for the rapid deployment of new software-centric capabilities to unlock service interoperability and data sharing,” says Caret.

F-15EX

For example, the F-15EX uses a digital backbone and open mission systems architecture to easily incorporate next generation technologies like hypersonic payloads and advanced software-based capabilities. By designing F-15EX to be digitally native, Boeing enables the Air Force to use either Boeing or third-party software. This maximizes the customer's flexibility to rapidly upgrade or field new capabilities regardless of vendor, and ensures dominance against all adversaries, present and future.

Accelerating the digital revolution through culture change

Engineering, production and product support innovation – and the technology breakthroughs embedded in those activities – is part of Boeing's cultural DNA. From the first lines of software code to the fielded product, digital tools and platform data allow Boeing to focus its engineering expertise on solving problems earlier in the design process to increase first-time quality and save time and money – not just in acquisition but throughout the entire service life of the product, reducing the overall cost of ownership.

"Our global customers are asking us to deliver more predictable outcomes and to increase our learning agility so that we can prepare for and react to emerging challenges better together," said Colbert. "Our ability to combine digital tools and outcome-centered thinking with proven engineering, manufacturing and services approaches is the changing the industry."

"It's about who provides the best value and speed to market with connected, open systems," added Caret. "And accelerating the entire lifecycle – from requirements definition through design, production, test, maintenance and upgrades. Boeing stands ready to deliver."